Original Research Article

Effect of mexcian sunflower (*Tithonia diversifolia*) extract on the growth and herbage yield of lemon grass (*cymbopogon flexuosus*) var. krishna

ABSTRACT

A field experiment was conducted in the Medicinal plant unit, Department of Horticulture, Faculty of Agriculture, Annamalai university to study the effect of mexcian sunflower (*Tithonia diversifolia*) leaf extract on the growth and herbage yield of lemon grass (*Cymbopogon flexuosus* var. krishna). The experiment was laid out in a Randomized Block Design with nine treatments and replication thrice. The treatments consisted of FYM (25 t ha^{-1}) and Tithonia extract at different concentration *viz.*, 5, 10, 15, 20, 25, 30, 35 and 40 per cent as foliar application on 15, 45, 75, 105, and 135 days after transplanting. The results of the experiment revealed that the combined application of FYM 25 t ha^{-1} + Tithonia extract per cent 40 per cent (T_9) produced the highest values for growth parameters such as plant height, number of tillers, plant spread (East-West and North-South), number of leaves $plant^{-1}$ and yield parameters such as fresh herbage, dry herbage yield and dry matter production (per plant, per plot and per hectare).

INTRODUCTION

Cymbopogon flexuosus (Nees ex Steud) Wats. belonging to the family Poaceae is known as Cochin or East Indian or Malabar lemongrass. It is a perennial aromatic cum medicinal herb native to the Indian subcontinent (Adinarayana *et al.*, 2012). The crop is extensively cultivated in the poor, marginal and waste lands and also along the bunds as live mulch. The well ramified root system of the plant helps in soil and water conservation. Lemongrass was one of the herbs to travel along the spice route from Asia to Europe.

Lemongrass oil of commerce is popularly known as Cochin oil in the world trade, since 90 per cent of it is shipped from Cochin port. It is grown in several countries particularly West Indies, China, Indonesia, Brazil, Congo, Republic of Malagasy, Sri Lanka, Zambia and other countries. In India it is cultivated along Western Ghats, Karnataka and Tamil Nadu states besides foothills of Arunanchal Pradesh and Sikkim (Srivastava *et al.*, 2013).

Lemon grass is commonly known for its higher citral content. The major constituents of root, stem and leaves are geraniol 30.5 per cent, citronellol 24.1 per cent, neral 10.3 per cent and geranial 13.6 per cent. Lemon grass oil is mainly used in the manufacture of perfumes for soaps, hair oils scents and medicines. It also has antibacterial properties. Ionone prepared from citral present in lemon grass oil is one of the most important raw material for the preparation of vitamin A. The use of lemon grass is part of a competitive market which includes pharmaceuticals, food, cosmetics, and perfumery markets. There are numerous examples of the application of lemongrass for health remedies by different ethnic groups (Ravinder *et al.*, 2010).

The yield and quality of lemongrass is mostly influenced by the climatic and agronomic management factors. The management of plant nutrition is a significant aspect that influences plant output. Organic farming system emphasise on the use of organic matters for maintaining soil health, growth and multiplication of beneficial microbes and minimizing health hazards associated with food (Badalingappanavar *et al.*, 2018). As conventional method of farming uses the chemical based fertilizers which are not useful in case of medicinal plants as use of chemical fertilizers had adverse effect on nature of secondary

metabolites. Organic method of cultivation is found to effectively enhancing the production quantitatively and qualitatively over chemical fertilizers. Beside their effectiveness these are easily available material in low cost and also helps in reduction in farm waste.

Farmyard manure (FYM) is a decomposed mixture of dung, urine, litter, and leftover materials from roughages and fodder fed to animals. A well-decomposed FYM contains 0.5–1.5 per cent Nitrogen, 0.2–0.4 per cent Phosphorus, and 0.5–1.0 per cent potassium. (Kumar *et al*., 2021).

Tithonia diversifolia commonly known as Mexican sunflower was probably introduced into West Africa as an ornamental plant. *Tithonia diversifolia* leaves are rich in essential nutrients such as nitrogen, phosphorus, potassium, and other micronutrients that are beneficial for plant growth. Chemical composition of *Tithonia diversifolia* is Nitrogen 1.76 per cent, Phosphorous 0.82 per cent, Potassium 3.92 per cent, Calcium 3 per cent and Magnesium 0.005 per cent (Olabode *et al.,* 2007). Using *Tithonia diversifolia* as a foliar spray is an organic method to provide nutrients to plants.

In view of the above the present study was carried out on the Standardization and effect of Mexican sunflower (*Tithonia diversifolia*) extract on the growth and herbage yield of lemon grass (*Cymbopogon flexuosus*) var. krishna.

Materials and methods

The field experiment was carried at Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during january – july, 2024. Geographical location of land and climatic condition of experimental site is geographically situated at 11° 24' North latitude and 79° 44' East longitude at an altitude of + 5.72 m above MSL. The experiment was laid out in a Randomized Block Design with nine treatments and replicated thrice. The treatments consisted of T_1- FYM 25 t ha^{-1} (Control), T_2-FYM 25 t ha^{-1} + Tithonia Extract 5%, T_3-FYM 25 t ha^{-1} + Tithonia Extract 10%, T_4-FYM 25 t ha^{-1} + Tithonia Extract 15%, T_5-FYM 25 t ha^{-1} + Tithonia Extract 20%, T_6-FYM 25 t ha^{-1} + Tithonia Extract 25%, T_7-FYM 25 t ha^{-1} + Tithonia Extract 30%, T_8-FYM 25 t ha^{-1} + Tithonia Extract 35%, T_9-FYM 25 t t ha^{-1}+ Tithonia Extract 40%. The growth parameters viz., plant height, number of tillers $plant^{-1}$, number of leaves $plant^{-1}$, plant spread (East-West and North-South) and yield parameters viz., fresh herbage yield and dry herbage yield were recorded from five tagged plant in each treatment at frequent intervals viz., 30, 60, 90, 120 and 150 DAP and the average value was computed for consideration of final data. Plant height was measured from ground level to the tip of longest leaf with the help of measuring tape. The plant spread was taken from two directions (East-West and North-South) and average value was expressed in cm. The number of tillers $plant^{-1}$ & number of leaves $plant^{-1}$ are manually counted and recorded. Hundred gram of fresh shoot of *Tithonia diversifolia* were harvested and chopped into 2-3 cm length and finely ground with mortar and pestle. The ground plant material was soaked in one litre of distilled water in a large beaker for 12 hours. The solution was filtered through cheese cloth to remove debris and finally filtered using Whatman No. 1 filter paper. The final filtrate served as the leaf extract of *Tithonia diversifolia.* The chlorophyll content index was recorded with the help of chlorophyll content index meter (Model CCM – 200 001 300. CE).

Result and discussion

Growth attributes

In the present study, it was observed that applying FYM 25 t ha^{-1} + Tithonia Extract 40 per cent (T_9) recorded the maximum plant height, number of tillers $plant^{-1}$, number of leaves $plant^{-1}$, plant spread (East-West and North-South) at 30, 60, 90, 120 and 150 DAP. The perusal

of data furnished in Table 1 shows that the maximum plant height with the values of 59.73, 101.03, 136.24, 78.36 and 115.29 cm at 30, 60, 90, 120 and 150 days after planting and the least plant height of 41.38, 71.40, 95.30, 55.45 and 89.36 cm respectively, were registered in the Control (T_1) which received only FYM 25 t ha^{-1}. The influence of spraying tithonia extract on number of tillers $plant^{-1}$ was found to be insignificant at 30 DAP, while the difference were found significant among various treatments at later growth of the stage. The maximum number of tillers $plant^{-1}$ registered with the values of 4.60, 16.93, 34.71, 42.54 and 58.02 at 30, 60, 90, 120 and 150 DAT. The least number of tillers (3.72, 7.23, 21.23, 26.31 and 35.17) recorded in the control (T_1).

FYM increases soil macro elements, such as nitrogen (N), phosphorous (P) and potassium (K), resulting in maximum NPK uptake by the crop and improved soil organic carbon as well as available N, P, and K for increased growth of forage grasses (Walie *et al.*, 2022). The increase in plant height might be due to greater availability of macronutrients from organic sources which helped in acceleration of various metabolic processes (Momin and Gajbhiye 2016). Organic matter and nutrients present in FYM contribute to the overall growth and development of plants, including an increase in plant height. The present results are in conformation with the findings of Anuja and Jayasri (2011) in sweet basil, Punam *et al*. (2012) in lemongrass. The highest plant height and number of tillers is due to amount of N, P, and K content present in tithonia. The N concentration in tithonia leaves is higher than the critical level of 2.0 to 2.5per cent, below which net immobilization of N, would be expected. The P concentration is also higher than the critical level of 0.25per cent for net P mineralization (Ademiluyi *et al.*, 2007). Phosphorus plays a crucial role in enhancing vegetative growth in plants by affecting soil nitrogen dynamics and promoting plant and microbial immobilization, ultimately leading to increased soil total nitrogen levels (Wang *et al.*, 2022). 'K' helps in photosynthesis, favors high energy status, maintains cell turgour, regulates opening of leaf stomata, promotes water uptake, regulates nutrients translocation in plant, favours carbohydrate transport, enhances N uptake, helps in protein synthesis and promotes starch synthesis (Mitra and Dhaliwal 2009). The present results are in conformation with the findings of Babajide *et al.* (2008) in tomato and Shokalu *et al.* (2009) in *Celosia argentea.*

It can be infered from the data presented in Table. 2 shows the maximum number of leaves recorded with the values of 14.04, 55.95, 152.52, 192.17 and 261.11 at 30, 60, 90, 120 and 150 DAP and the least value for leaf production was noticed in the treatment T_1 (control) with the values of 9.32, 28.92, 89.21, 102.32 and 161.94 respectively. It can be observed from the data presented in Table 3 that the maximum plant spread of East-West direction was registered the values of (39.82, 73.25, 98.08, 46.57 and 70.81 cm) at 30, 60, 90, 120 and 150 days after planting, while the least plant spread was registered in the control T_1 (FYM 25 t ha^{-1}) with the values of 25.36, 45.36, 68.36, 27.35 and 46.35 cm respectively. the maximum plant spread in North-South direction with the values of 19.93, 57.19, 87.99, 39.43 and 60.05 cm at 30, 60, 90, 120 and 150 days after planting respectively, Treatment T_1 (control) recorded the minimum plant spread 12.25, 38.45, 61.25, 17.36 and 37.36 cm respectively.

The highest number of leaves $plant^{-1}$and maximum plant spread (East-West and North South) was due to the soil application of FYM and foliar application of tithonia extract. Farmyard manure (FYM) plays a crucial role in enhancing soil fertility due to its optimal C: N ratio, which facilitates the release of nitrogen in readily available forms during decomposition (Vinayak *et al.*, 2022). The maximum number of leaves $plant^{-1}$ and plant spread (East-West and North-South) may be due to increase in soil nitrogen levels. This is in accordance with the finding of Shinde *et al.* (2013) in ashwagandha and Rashid *et al.* (2013) in stevia. The growth promotion could be explained by the high level of macro and micronutrients in *T. diversifolia* leaves and stems, essential for crop growth and positively involved as organic amendments in many physiological processes such as the molecular

structure of nucleic acid, the storage functions, the energy transfer processes within the plant and the roots developmet (Ewane *et al.*, 2020). This is in accordance with the findings of Aguyoh *et al.*, (2010) in watermelon.

Physiological attributes

The highest Chlorophyll Content Index (Table 2) at I Harvest (90 DAP) and II Harvest (150 DAP) with values of 25.85 and 28.77 and the least in control (T_1) with the values of 12.83 and 13.29. Chlorophyll is a vital pigments in plant photosynthesis, absorbing sunlight and transferring energy efficiently. They have diverse absorption bands in the visible and near-infrared regions, crucial for plant growth and development (Paterson 2023). The increasing chlorophyll content was due to the presence of microorganisms in the FYM that colonizes in the rhizosphere and stimulate the plant growth and biochemical contents (Ravimycin 2016). This is in line with the findings of (Chaurasia and Singh (2021) in Ashwagandha. Organic manures are good sources of nitrogen, which favour chlorophyll production. Nitrogen supply affects leaf growth because it increases the leaf area of plants thus influencing photosynthesis. Photosynthetic proteins represent a large proportion to total leaf N (Devkota and Jha 2013). The green leaf biomass of tithonia is high in nutrients, averaging about 3.5% Nitrogen, 0.37% Phosphorous and 4.1% potassium on dry matter basis (Jama *et al.*, 2000), Which helps in photosynthesis.

Yield attributes

It can be infered from the data presented in Table. 4&5 shows that the maximum fresh herbage production at I Harvest and II Harvest (280.30 g plant^{-1}, 2.14 kg plot^{-1} and 13.24 t ha^{-1} and 320.81 g plant^{-1}, 2.45 kg plot^{-1} and 15.15 t ha^{-1}) and dry herbage yield I Harvest and II Harvest (56.06 g plant^{-1}, 0.43 Kg plot^{-1} and 2.65 t ha^{-1} and 64.16 g plant^{-1}, 0.49 Kg plot^{-1} and 3.03 t ha^{-1}) was recorded in plants supplied with FYM 25 t ha^{-1} + Tithonia extract 40 per cent (T_9), which could have attributed to the better growth of the plants as reflected in yield contributing characters such as plant height, number of tillers plant^{-1}, plant spread (East-West and North-South) and number of leaves plant^{-1}. The increased in yield parameters was due to increase in plant height, number of tillers plant^{-1}, number of leaves plant^{-1} and largest leaves leading to higher dry matter accumulation in plants and translocation of photosynthates from source to sink which might due to sufficient availability of major and micronutrients from FYM, helped in the uptake of more nutrients (Muruganandam *et al.*, 2021).

Organic manures, as noted by Krishnamoorthy and Ravikumar (1973), can enhance plant growth through various mechanisms. Their high humus content promotes microbial nitrogen fixation, ensuring a steady supply of nitrogen to plants. Additionally, organic manures may stimulate the production of plant growth hormones. This combination of factors can lead to extended leaf area duration, allowing for increased photosynthetic rates and, ultimately, higher dry matter accumulation (Padmanaban, 2003). Similar findings have been reported for sweet basil by Yadav *et al.* (2023). FYM also help to improve soil physical conditions which make the plant roots to proliferate better for utilisation of nutrients to boost up the yield (Rathore 2021). Increased yield parameters on application of increased level of FYM might also be due to enhanced canopy photosynthesis through increased vegetative growth of crop (Rahman *et al.*, 2004). This is in accordance with the findings of Priya *et al.* (2018) in sweet flag.

Gaur, 1991 suggested that FYM might act directly in increasing the crop yield either by acceleration of respiratory process with increasing cell permeability and hormonal growth action. It supplies nitrogen, phosphorus, potassium and micronutrients like Iron, Sulphur, Molybdenum and Zinc *etc*, in available forms to the plants through biological decomposition

and improves soil physio-chemical properties such as aggregation, aeration, permeability, water holding capacity, slow release of nutrients and increase in cation exchange capacity and stimulation of soil as flora and fauna. This results are in agreement with the findings of Umesh *et al.* (2007) in medicinal solanum and Sharaf *et al.* (2013). Additionally, Previous crops and tillage practices in an experimental field can impact soil nitrogen availability and microbial activity, which subsequently influence the mineralization rate of FYM.

Foliar fertilization has the ability to improve the effciency and rapidity of utilization of a nutrient urgently required by the plant for maximum growth and yield (Alshaal *et al*., 2017). The spraying of tithonia extract @ 40 per cent was found to be the best treatment due to the effect of increased nitrogen, phosphorous and potassium in the tithonia extract (Abeyrathne *et al*., 2021). This finding is consistent with the reports of Parman (2007) in potato and Zhai *et al.* (2009) in tomato.

Table 1. Effect of Tithonia extract on Plant height (cm) and Number of tillers plant^{-1} of Lemon grass (*Cymbopogon flexuosus*) var. krishna

TREATMENTS	Plant height (cm)					Number of tillers plant^{-1}				
	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP
T_1- FYM 25 t ha^{-1} (Control)	41.38	71.40	95.30	55.45	89.36	3.72	7.23	21.23	26.31	35.17
T_2-FYM 25 t ha^{-1} + Tithonia Extract 5%	41.44	71.94	96.19	55.92	90.38	3.89	7.41	21.65	26.80	35.80
T_3-FYM 25 t ha^{-1} + Tithonia Extract 10%	42.06	72.57	97.43	56.44	91.64	4.10	7.61	22.14	27.32	36.52
T_4-FYM 25 t ha^{-1} + Tithonia Extract 15%	45.32	77.83	104.95	60.60	92.00	4.23	9.07	24.26	29.84	40.38
T_5-FYM 25 t ha^{-1} + Tithonia Extract 20%	46.18	78.62	106.36	61.23	93.36	4.36	9.29	24.77	30.40	41.20
T_6-FYM 25 t ha^{-1} + Tithonia Extract 25%	49.50	83.93	113.70	65.50	98.75	4.43	10.96	27.11	32.97	45.31
T_7-FYM 25 t ha^{-1} + Tithonia Extract 30%	52.84	89.41	121.11	69.72	104.17	4.54	12.79	29.54	35.86	49.50
T_8-FYM 25 t ha^{-1} + Tithonia Extract 35%	56.25	95.14	128.64	74.01	109.70	4.58	14.80	32.10	38.98	53.73
T_9-FYM 25 t ha^{-1} + Tithonia Extract 40%	59.73	101.03	136.24	78.36	115.29	4.60	16.93	34.71	42.54	58.02
S. Ed	1.18	2.02	2.73	1.57	2.40	NS	0.27	0.65	0.80	1.09
CD (P=0.05)	3.07	4.29	5.78	3.34	5.10	NS	0.58	1.38	1.70	2.31

Table 2. Effect of Tithonia extract on number of leaves plant^{-1} and chlorophyll content index (CCI) of Lemon grass (*Cymbopogon flexuosus*) var. Krishna

TREATMENT	Number of leaves plant^{-1}					chlorophyll content index (CCI)		
	30 DAP	60 DAP	90 DAP (I Harvest)	120 DAP	150 DAP (II Harvest)	90 DAP (I Harvest)	150 DAP (II Harvest)	MEAN
T_1- FYM 25 t ha^{-1} (Control)	9.32	28.92	89.21	102.32	161.94	12.83	13.29	13.06
T_2-FYM 25 t ha^{-1} + Tithonia Extract 5%	9.48	30.12	91.53	103.44	165.07	13.07	13.50	13.29
T_3-FYM 25 t ha^{-1} + Tithonia Extract 10%	9.68	31.41	93.92	104.63	168.39	13.36	13.76	13.56
T_4-FYM 25 t ha^{-1} + Tithonia Extract 15%	10.38	35.23	104.89	120.88	185.60	15.39	16.22	15.81
T_5-FYM 25 t ha^{-1} + Tithonia Extract 20%	10.61	36.59	107.58	122.10	189.10	15.72	16.55	16.14
T_6-FYM 25 t ha^{-1} + Tithonia Extract 25%	11.38	40.82	118.60	138.79	206.62	17.98	19.27	18.63
T_7-FYM 25 t ha^{-1} + Tithonia Extract 30%	12.19	45.34	129.81	156.02	224.48	20.27	22.16	21.21
T_8-FYM 25 t ha^{-1} + Tithonia Extract 35%	13.08	49.96	141.13	173.94	242.67	22.59	25.18	23.88
T_9-FYM 25 t ha^{-1} + Tithonia Extract 40%	14.04	55.95	152.52	192.17	261.11	25.85	28.77	27.31
S. Ed	NS	0.98	2.84	3.38	4.95	0.43	0.47	-
CD (P=0.05)	NS	2.09	6.02	7.18	10.51	0.93	1.01	-

Table 3. Effect of Tithonia extract on Plant spread (East-West) and (North- South) (cm) of Lemon grass (*Cymbopogon flexuosus*) var. krishna

TREATMENT	Plant spread (East-West) (cm)					Plant spread (North- South) (cm)				
	30 DAP (cm)	60 DAP (cm)	90 DAP (I Harvest) (cm)	120 DAP (cm)	150 DAP (II Harvest) (cm)	30 DAP (cm)	60 DAP (cm)	90 DAP (I Harvest) (cm)	120 DAP (cm)	150 DAP (II Harvest) (cm)
T_1- FYM 25 t ha^{-1} (Control)	25.36	45.36	68.36	27.35	46.35	12.25	38.45	61.25	17.36	37.36
T_2-FYM 25 t ha^{-1} + Tithonia Extract 5%	25.56	46.56	69.65	27.65	47.24	12.45	39.05	62.27	17.71	38.10
T_3-FYM 25 t ha^{-1} + Tithonia Extract 10%	26.36	48.02	71.29	28.33	48.26	12.78	39.93	63.73	18.39	39.08
T_4-FYM 25 t ha^{-1} + Tithonia Extract 15%	27.96	51.61	75.82	30.83	51.55	13.80	42.43	67.69	21.64	42.31
T_5-FYM 25 t ha^{-1} + Tithonia Extract 20%	28.31	54.13	77.74	31.85	52.79	14.25	43.73	69.38	22.87	43.52
T_6-FYM 25 t ha^{-1} + Tithonia Extract 25%	30.50	59.01	82.42	34.74	56.68	15.57	46.49	73.58	26.52	47.21
T_7-FYM 25 t ha^{-1} + Tithonia Extract 30%	33.36	64.19	87.40	38.39	60.91	16.98	49.69	78.12	30.49	51.19
T_8-FYM 25 t ha^{-1} + Tithonia Extract 35%	36.48	69.85	92.63	42.28	65.60	18.40	53.29	82.98	34.78	55.40
T_9-FYM 25 t ha^{-1} + Tithonia Extract 40%	39.82	73.25	98.08	46.57	70.81	19.93	57.19	87.99	39.43	60.05
S. Ed	0.78	1.47	2.05	0.88	1.42	0.36	1.17	1.84	0.67	1.18
CD (P=0.05)	1.59	2.99	4.18	1.80	2.90	0.79	2.38	3.74	1.38	2.41

Table 4. Effect of Tithonia extract on fresh herbage yield of lemon grass (*Cymbopogon flexuosus)* var. krishna

TREATMENT	90 DAP I HARVEST (g Plant^{-1})	90 DAP I HARVEST (kg plot $^{-1}$)	90 DAP I HARVEST (t ha $^{-1}$)	150 DAP II HARVEST (g Plant^{-1})	150 DAP II HARVEST (kg plot $^{-1}$)	150 DAP II HARVEST (t ha $^{-1}$)
T_1- FYM 25 t ha^{-1} (Control)	123.62	0.9457	5.84	170.32	1.30	8.04
T_2-FYM 25 t ha^{-1} + Tithonia Extract 5%	126.83	0.9702	5.99	173.34	1.33	8.19
T_3-FYM 25 t ha^{-1} + Tithonia Extract 10%	130.36	0.9973	6.16	176.55	1.35	8.34
T_4-FYM 25 t ha^{-1} + Tithonia Extract 15%	158.01	1.2088	7.46	201.69	1.54	9.52
T_5-FYM 25 t ha^{-1} + Tithonia Extract 20%	161.90	1.2385	7.65	205.16	1.57	9.69
T_6-FYM 25 t ha^{-1} + Tithonia Extract 25%	189.93	1.4530	8.97	231.52	1.77	10.93
T_7-FYM 25 t ha^{-1} + Tithonia Extract 30%	218.49	1.6714	10.32	258.91	1.98	12.23
T_8-FYM 25 t ha^{-1} + Tithonia Extract 35%	249.28	1.9070	11.77	288.55	2.21	13.63
T_9-FYM 25 t ha^{-1} + Tithonia Extract 40%	280.30	2.1443	13.24	320.81	2.45	15.15
S. Ed	4.65	0.04	-	5.65	0.03	-
CD (P=0.05)	9.86	0.10	-	11.97	0.07	-

Table 5. Effect of Tithonia extract on dry herbage yield of lemon grass (*Cymbopogon flexuosus)* var. krishna

TREATMENT	90 DAP I HARVEST (g Plant^{-1})	90 DAP I HARVEST (kg plot $^{-1}$)	90 DAP I HARVEST (t ha $^{-1}$)	150 DAP II HARVEST (g Plant^{-1})	150 DAP II HARVEST (kg plot $^{-1}$)	150 DAP II HARVEST (t ha $^{-1}$)
T_1- FYM 25 t ha^{-1} (Control)	24.72	0.19	1.17	34.06	0.26	1.61
T_2-FYM 25 t ha^{-1} + Tithonia Extract 5%	25.37	0.19	1.20	34.67	0.27	1.64
T_3-FYM 25 t ha^{-1} + Tithonia Extract 10%	26.07	0.20	1.23	35.31	0.27	1.67
T_4-FYM 25 t ha^{-1} + Tithonia Extract 15%	31.60	0.24	1.49	40.34	0.31	1.90
T_5-FYM 25 t ha^{-1} + Tithonia Extract 20%	32.38	0.25	1.53	41.03	0.31	3.77
T_6-FYM 25 t ha^{-1} + Tithonia Extract 25%	37.99	0.29	1.79	46.30	0.35	2.19
T_7-FYM 25 t ha^{-1} + Tithonia Extract 30%	43.70	0.33	2.06	51.78	0.40	2.45
T_8-FYM 25 t ha^{-1} + Tithonia Extract 35%	49.86	0.38	2.35	57.71	0.44	2.73
T_9-FYM 25 t ha^{-1} + Tithonia Extract 40%	56.06	0.43	2.65	64.16	0.49	3.03
S. Ed	1.38	0.004	-	0.37	0.02	-
CD (P=0.05)	2.93	0.01	-	0.79	0.06	-

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